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SARCOTACES, A GENUS OF PARASITIC COPEPODS (CYCLOPOIDA: PHILICHTHYIDAE), FOUND ON JAPANESE FISHES[1)]

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The genus *Sarcotaces* Olsson has thus far been known from four species. These are *S. verrucosus* Olsson, 1872, parasitic on *Acanthurus* sp. from the West Indies, *S. arcticus* Collett, 1874, on *Molva abyssorum* from Norway, *S. pacificus* Komai, 1924, on *Antennarius* sp., and *S. komaii* Shiino, 1953, on *Peristedion amiscus*. The last two and *Sarcotaces* sp. Yamaguti, 1963, taken from *Semicossyphus reticulatus* belong to the species found in Japan.

Recently, the author obtained two lots of specimens of the parasites belonging to this genus at Seto, Wakayama Prefecture, one from a frogfish, *Antennarius tridens*, and the other from a moray eel, *Gymnothorax kidako*. They were *S. pacificus* and a new species which is to be described here under the name of *S. japonicus* n. sp. In addition to them, through the kindness of Dr. S. M. Shiino, the author could have an opportunity of examining his specimens of *S. komaii* obtained from an armoured gurnard, *Peristedion amiscus*, and unexamined specimens parasitic on a conger eel, *Promyllantor nezumi*. The latter host yielded a new species *S. shiinoi* n. sp., named after the original discoverer.

The present paper deals with those four Japanese species. Detailed examination of them revealed the presence of two pairs of antennae in the females and could disclose the region occupied by the head. It had been undetermined to what extent the head covers the peri-oral area owing to the lack of knowledge on the antennae. As long as those four species were concerned, the constitution of the female antennules provided a good specific character. As the male showed certain variations in its configuration, measurements were taken across various portions of the body in all the specimens of the four species and compared one another in respective species to see their relative value. In all of them except *S. japonicus*, whose male hardly showed any variations, all the males were figured in order to show interspecific differences.

The specimens preserved in alcohol were cleared in lactic acid for a few days

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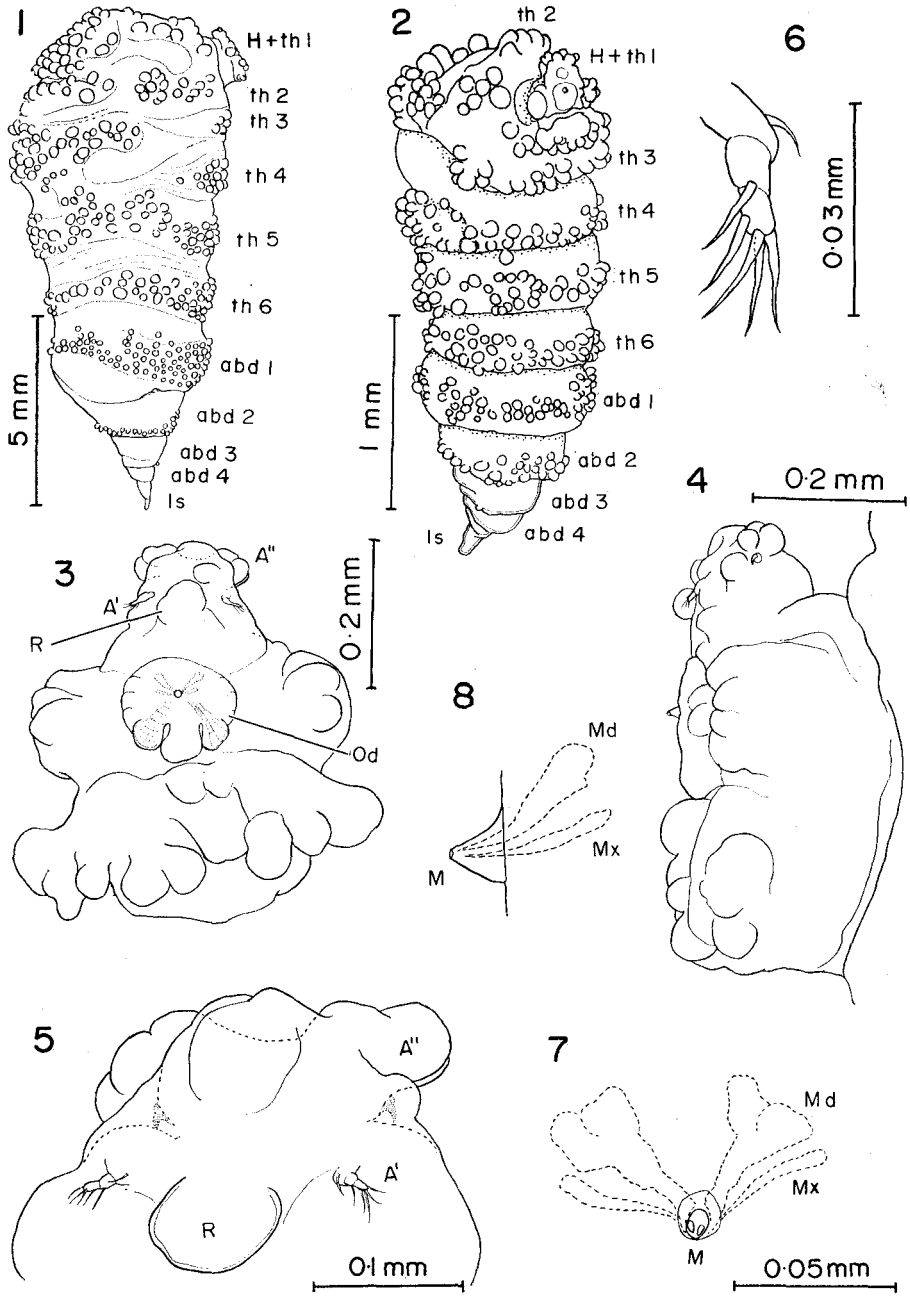
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before the microscopic examination. The male and the head isolated from the female were examined by Humes & Gooding's wooden slide.

Descriptions

Sarcotaces pacificus Komai, 1924

(Figs. 1–13)

Material examined: Three mature females and two juveniles, each associated with a male, were collected from several individuals of *Antennarius tridens* (Temmink & Schlegel) obtained in Tanabe Bay, Wakayama Prefecture, and kept alive in the aquarium of the Seto Marine Biological Laboratory, in October, 1971.

Female: Length 1.9–13.0 mm. Egg-filled oviduct forming a fine net-work can be seen through body wall in full adults, but invisible in juveniles. Body surface tuberculated from fore end to second abdominal segment. Tubercles round and not lobated.

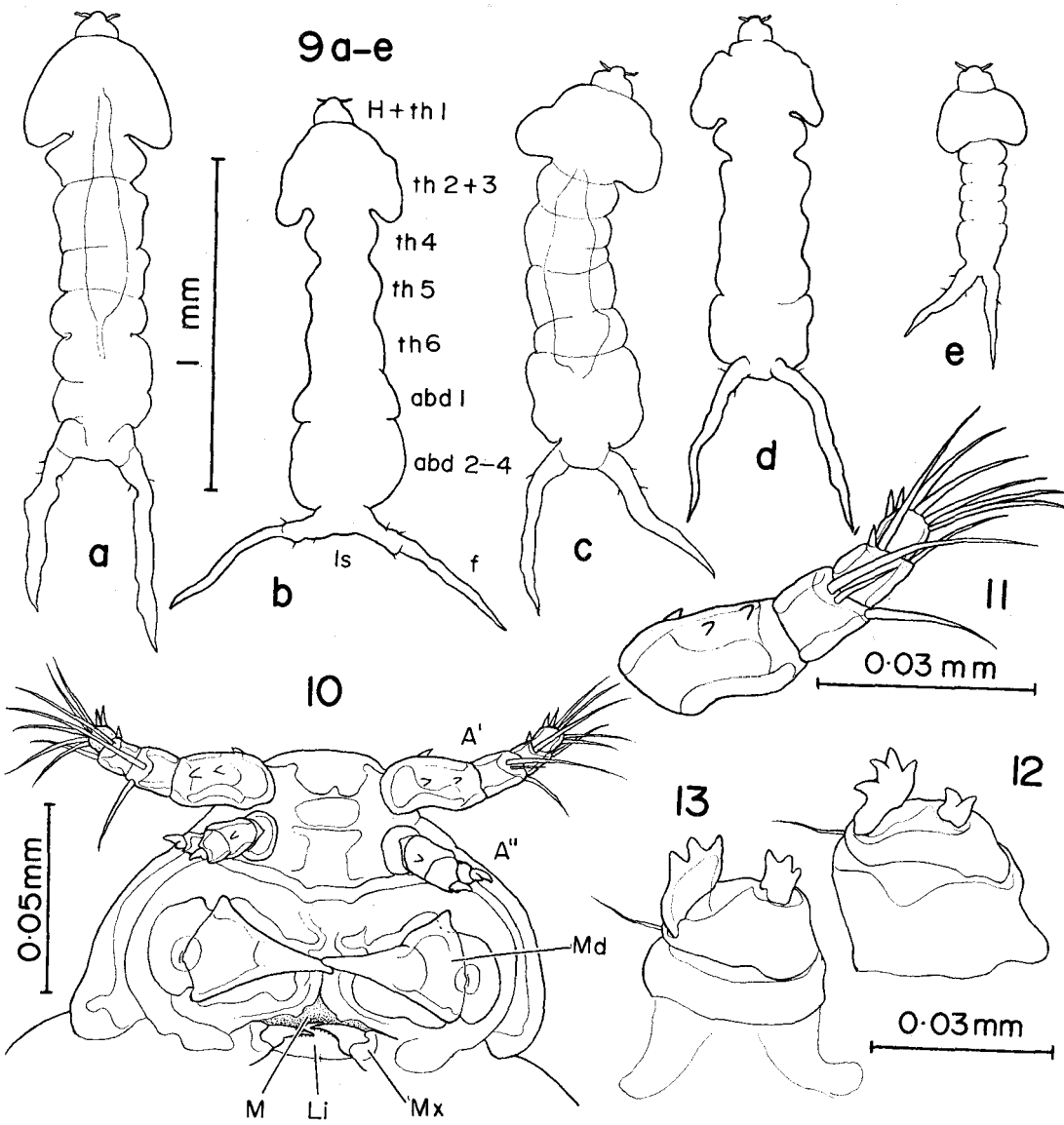
Head a disc-like elevation, located near fore end between second and third thoracic segments. It is one eighth as long as body in a larger specimen, one sixth in a smaller one, and divisible into antennary, oral and post-oral regions. Antennary region projecting forward, with a globular rostrum in the middle, with first antennae just before it on either side, and with rudimentary second antennae at fore end. First antenna finger-shaped, indistinctly three-segmented, and with six setae. Second antenna represented by a fleshy protuberance carrying a basal claw. Oral region occupying the middle of head, expanded laterally, and with raised oral disc at the center. Mandible and maxilla styliform buried in the skin, and arranged radially around the mouth. The former has broader base. Post-oral region corresponding to first thoracic segment abounds in protuberances.

Male:

	Range of variations	Mean
Body length (mm)	1.1–1.4	1.25
Head width/maximum width of thorax	0.27–0.32	0.30
Head width/maximum width of abdomen	0.34–0.46	0.39
Maximum width of thorax/body length	0.29–0.36	0.34
Maximum width of abdomen/body length	0.22–0.29	0.27
Length of caudal furca/body length	0.41–0.51	0.46

Juvenile 0.6 mm long (Fig. 9e) is excluded.

Figs. 1–8. *Sarcotaces pacificus* Komai, female. 1. total view, lateral. 2. juvenile, ventro-lateral view. 3. head, ventral view. 4. same, lateral view. 5. antennary region, ventral view. 6. first antenna, ventral view. 7. mouth, ventral view. 8. same, lateral view, same magnification. Abbreviations: A′=first antenna, A″=second antenna, abd=abdominal segment, f=caudal furca, Gp=gonopore, H=head, Li=labium, ls=last segment, M=mouth, Md=mandible, Mx=maxilla, Od=oral disc, P′=first leg, P″=second leg, R=rostrum, Sp=sperm reservoir, th=thoracic segment.



Figs. 9–13. *Sarcotaces pacificus* Komai, male. 9a–e. total views of five males, dorsal. 10. head, ventral view. 11. first antenna, ventral view. 12. first thoracic leg, posterior view. 13. second thoracic leg, posterior view, magnification same as in Fig. 12.

Body relatively wider than in other species. Trunk segments more or less indicated by lateral notches. Caudal furca thicker, but shorter than in the rest species.

Head with four pairs of appendages. First antenna four-segmented, with short stout spines on anterior side, and setose on distal three segments. Second antenna also four-segmented, with a short spine on second segment and two claws on terminal two segments. Other appendages correspond to mandibles and maxillae. Mouth is a longitudinal slit between mandibles and leads to pharynx just in front of maxillae. Mandible consists of a broad base and a stout geniculated claw. Maxilla located just outside the labium, two-segmented; terminal segment unguiform, finely dentate.

Sarcotaces komaii Shiino, 1953

(Figs. 14–20)

Material examined: Shiino's specimens comprising ten females and eight males were obtained from the galls on the snout of several individuals of *Peristedion amiscus* Jordan & Starks, taken in Tosa Bay, Kochi Pref., on unknown date, and in the Sea of Kumano, Mie Pref., in 1952.

Female: Length 9.5–25.0, width 4.0–11.0 mm. Body surface tuberculate from fore end to second abdominal segment. Tubercles round, not lobated, larger in anterior portion of body, gradually diminishing in size towards the posterior.

Head similarly structured as in other species, though richer in protuberances. First antenna two-segmented; basal segment triangular, fused with sternal surface along its broad base and with two sub-terminal setae; terminal segment minute, tipped with three setae. Oral disc with a small medio-anterior protuberance and marginal lobations. Mouth and two pairs of oral appendages as in other species.

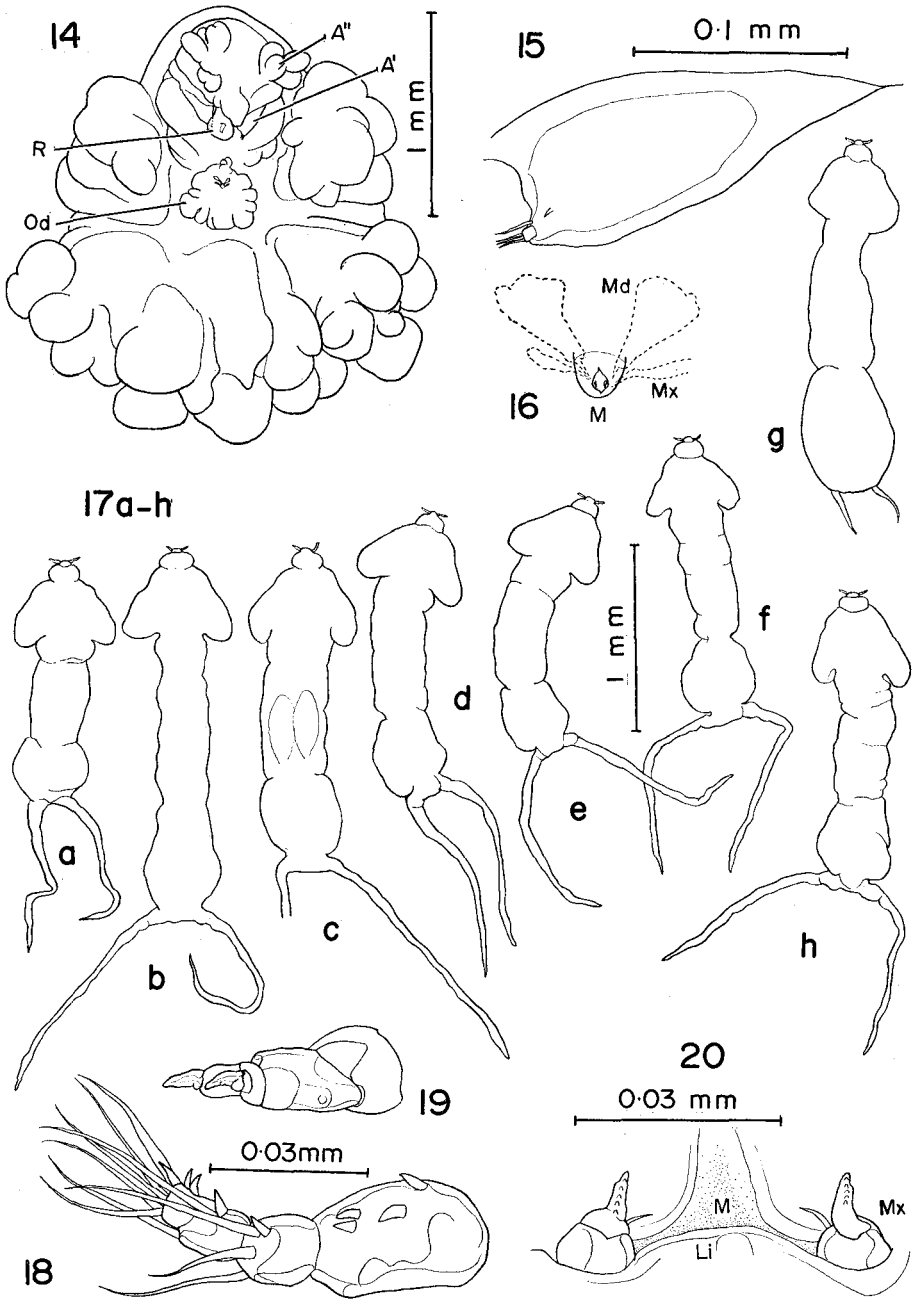
Male:

	Range of variations	Mean
Body length (mm)	1.3–2.0	1.62
Head width/maximum width of thorax	0.30–0.36	0.34
Head width/maximum width of abdomen	0.33–0.46	0.41
Maximum width of thorax/body length	0.27–0.40	0.31
Maximum width of abdomen/body length	0.18–0.32	0.25
Length of caudal furca*/body length	0.62–0.84	0.71

* One specimen having abnormally short caudal furcae (Fig. 17g) is omitted.

Body slender, without showing any distinct metamerism. Posterior portion of trunk more or less swollen. Caudal furca narrow and long.

First antenna four-segmented, with short stout spines on anterior side on all



Figs. 14–20. *Sarcotaces komaii* Shiino. Female: 14. head, ventral view. 15. first antenna, ventral view. 16. mouth, ventral view, magnification same as in Fig. 15. Male: 17a–h. total views of eight males, dorsal. 18. first antenna, ventral view. 19. second antenna, ventral view, magnification same as in Fig. 18. 20. maxillae in situ, ventral view.

segments, and setose on distal three. Second antenna and mandible almost as in the previous species. Maxilla two-segmented; first segment with a seta on the inner distal margin, second segment transformed into a serrated claw.

Sarcotaces japonicus n. sp.

(Figs. 21–37)

Material examined: Twelve females and seven males were obtained from the galls formed on the wall of the buccal cavity of several individuals of *Gymnothorax kidako* (Temmink & Schlegel), taken in Tanabe Bay, Wakayama Pref., in January, 1972. Holotypic female and nine paratypes (5 females, 4 males) deposited in the Seto Marine Biological Laboratory; the remaining paratypes in the collection of the author.

Female: 9.0–22.0 mm long, 4.2–9.0 mm wide, 14.7×6.3 mm on an average. Body ten-segmented, maggot-like in appearance, broadly rounded anteriorly, tapering posteriorly, and light brownish yellow in color. Thorax covered with large, more or less apically lobated tubercles. First to third abdominal segments more densely covered with smaller tubercles, in the first all around its circumference, but in the succeeding two only on the ventral side. Last segment bifurcate at the end unlike other species.

Head abounds in protuberances. First antenna elongate, unsegmented, swollen in the middle and tipped with five setae. Second antenna represented by a protuberance carrying a claw. Oral disc with a medio-anterior protuberance, and marginally lobated. Mouth and two pairs of oral appendages as in other species. Mandible cuneiform, indistinctly two-segmented.

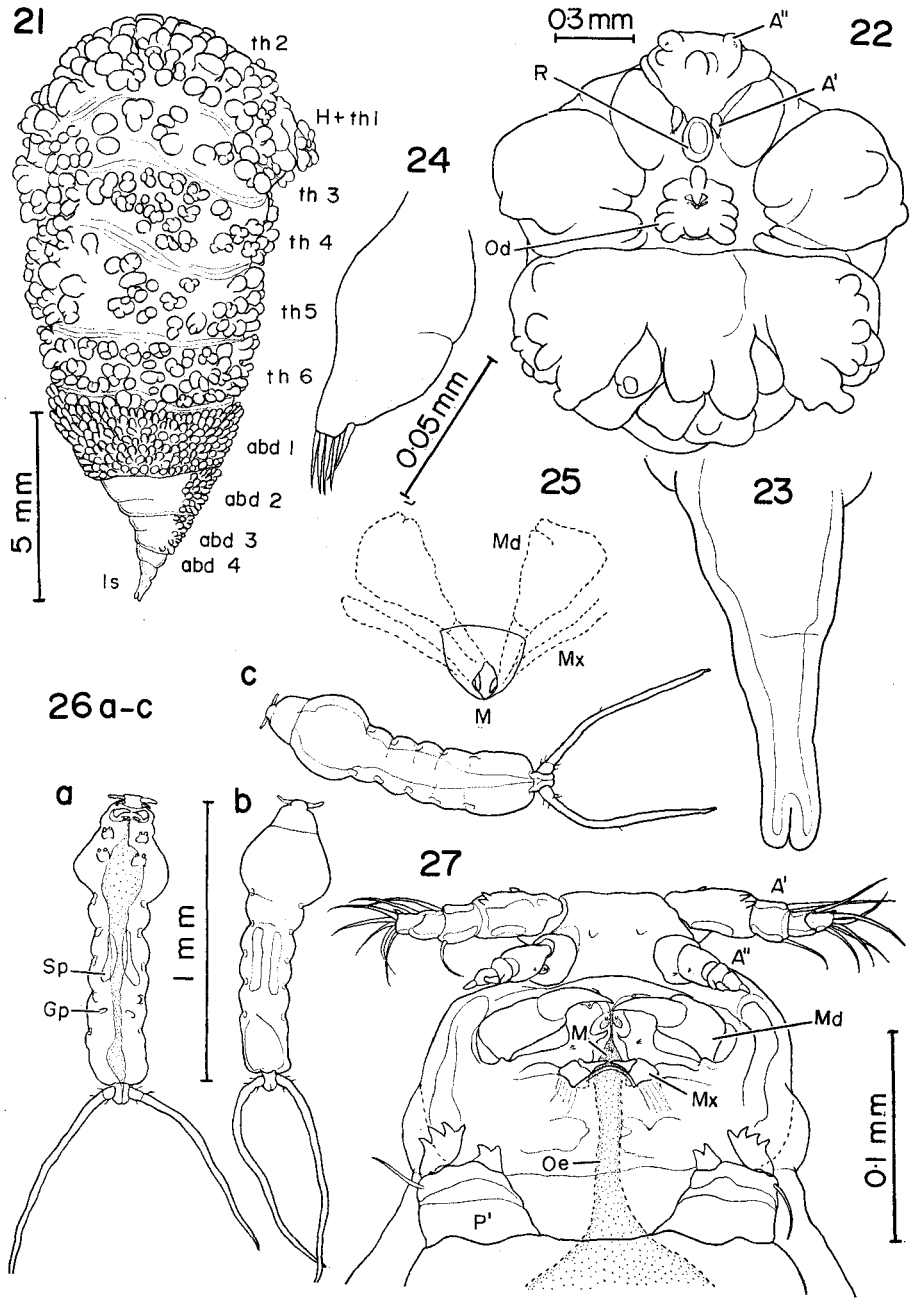
Male: In the seven specimens, body varies very little in shape, though one of them has abnormally short caudal furcae.

	Range of variations	Mean
Body length (mm)	1.0–1.1	1.04
Head width/maximum width of thorax	0.55–0.58	0.56
Head width/maximum width of abdomen	0.72–1.0	0.89
Maximum width of thorax/body length	0.27–0.28	0.28
Maximum width of abdomen/body length	0.17–0.21	0.19
Length of caudal furca*/body length	0.53–0.82	0.72

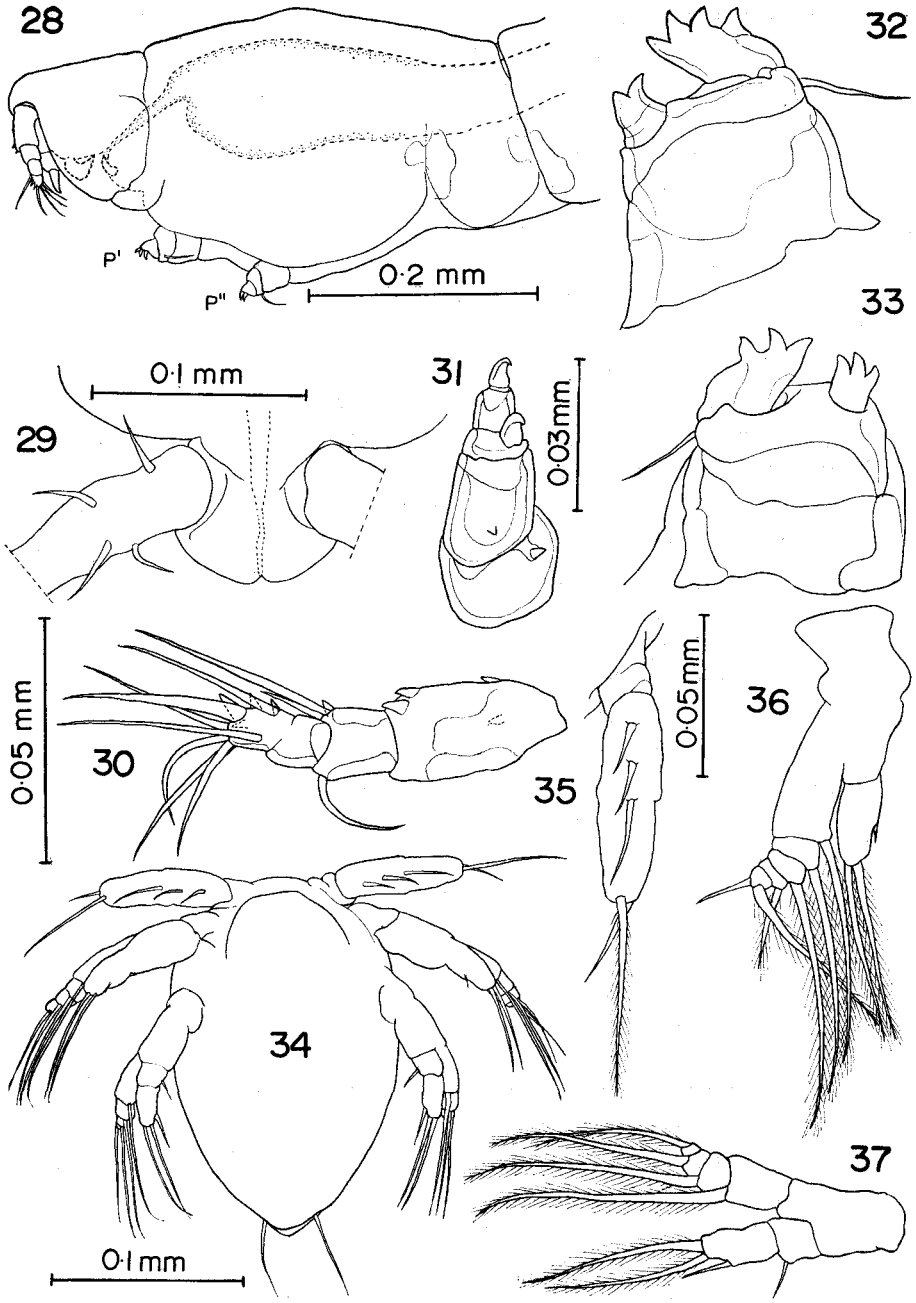
* One specimen with abnormally short caudal furcae is excluded.

Body pale white, transparent, more or less distinctly segmented. Alimentary tract with dark contents runs straight along the midline, terminating at anus at the hind end.

Head, with four pairs of appendages, about half as wide as first trunk segment



Figs. 21–27. *Sarcotaces japonicus* n. sp. Female: 21. total view, lateral. 22. head, ventral view. 23. last segment, dorsal view, magnification same as in Fig. 22. Male: 26a–c. total views of three males, a, ventral view, b & c, dorsal view. 27. head, ventral view.



Figs. 28–37. *Sarcotaces japonicus* n. sp. Male: 28. head and thorax, lateral view. 29. last segment, ventral view. 30. first antenna, ventral view. 31. second antenna, ventral view. 32. first thoracic leg, posterior view, magnification same as in Fig. 31. 33. second thoracic leg, posterior view, magnification same as in Fig. 31. First nauplius: 34. total view, ventral. 35. first antenna, ventral view. 36. second antenna, ventral view, magnification same as in Fig. 35. 37. mandible, ventral view, magnification same as in Fig. 35.

which is broadest of all segments, gently round on sides, never forming wing-like lamellae. Succeeding five segments definable by lateral notches, almost constant in width, and limbless. Anterior three segments stand for thorax and the rest for abdomen. A pair of rod-shaped, iridescent structures seen through the cuticle of last two thoracic segments may probably represent the sperm reservoirs. First abdominal segment carries gonopores on the ventral side. Penultimate segment longer than the preceding one, containing somewhat opaque substance within. Last segment much narrowed, distinctly bordered anteriorly, and with a medio-posterior notch. Caudal furca distinct from the last segment, and with four setae near the base.

First antenna four-segmented, with short, stout spines in each segment on the anterior side, and setose on distal three segments. Second antenna also four-segmented, with a tiny spine in proximal two segments and a stout claw on distal two. Mouth opens between mandibles as a longitudinal groove. Maxilla lies laterally to labium. Mandible consisting of a broad base and a strong claw articulated to it; the base almost entirely fused with sternal surface. Maxilla also two-segmented; terminal segment unguiform, non-dentate. Two pairs of legs as in other species, though the first pair closer to head than in others.

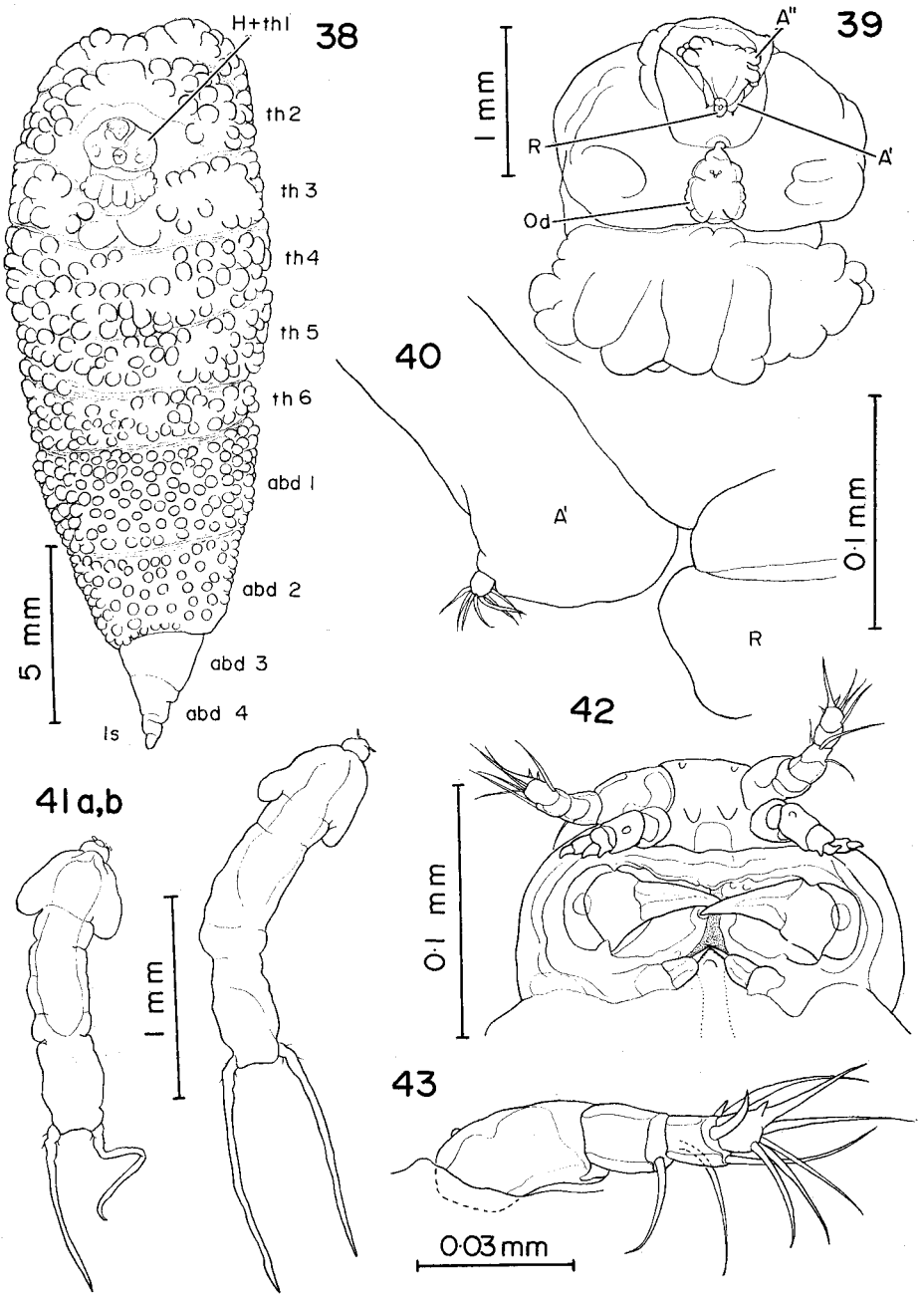
First nauplius: A large number of first nauplii may be found in the gall together with the female parasite. They are quite similar to those of *S. pacificus* (Izawa 1973) except for the setation on first two-segmented antenna. The first segment is short, fused with the body surface, and the second is armed with three proximal (one in *pacificus*) and two apical setae. Thus the first antenna of both Japanese species differs from that of *arcticus* described by Kuitunen-Ekbaum (1957, Fig. 2a, b), which is three-segmented and carries one seta on each of proximal two segments, besides two terminal setae.

Sarcotaces shiinoi n. sp.

(Figs. 38–43)

Material examined: An unexamined specimen of *Promyllantor nezumi* Asano carrying two galls in the peri-anal area was found in Shiino's collection. The 21 cm long host fish was taken off Owase, in the Sea of Kumano, Mie Pref., in 1958 and preserved in formalin. Two galls, which yielded two couples of parasites, were in contact with the peritoneum on the inner side, their inner cavity communicating with the exterior by a small pore just behind the anus. Holotypic female and three paratypes (1 female, 2 males) deposited in the Faculty of Fisheries, Prefectural University of Mie.

Female: One female 8.6×2.9 mm, the other 21.1×7.5 mm. Body maggot-like in appearance as in other species, but slenderer, about three times as long as wide, and light yellow in color. Dark contents of alimentary canal visible through the



Figs. 38–43. *Sarcotaces shiinoii* n. sp. Female: 38. total view, ventral. 39. head, ventral view. 40. first antenna and rostrum, ventral view. Male: 41a, b. total views of two males, dorsal. 42. head, ventral view. 43. first antenna, dorsal view.

skin. Body surface tuberculate from fore end to second abdominal segment. Tubercles round and not lobated.

Head about one eighth as long and two sevenths as wide as body, and structured more or less similarly as in other species, but scarce in protuberance. First antenna two-segmented; first segment fused with head surface along its broad base, terminal segment minute and tipped with seven setae. Second antenna represented by a few protuberances aggregated at each antero-lateral angle of head. Oral disc ovoid, with a medio-anterior protuberance and several shallow marginal notches. Mouth and two pairs of oral appendages as in other species.

Male:

	Specimen a.	Specimen b.
Body length (mm)	1.5	1.8
Head width/maximum width of thorax	0.31	0.30
Head width/maximum width of abdomen	0.50	0.50
Maximum width of thorax/body length	0.35	0.27
Maximum width of abdomen/body length	0.21	0.19
Length of caudal furca/body length	0.58	0.66

Body slender, broadest in post-cephalic region which is formed by fusion of second and third thoracic segments. The fused segment nearly triangular, produced laterally into a pair of wing-like lamellae, and with two pairs of legs. Rest segments indistinctly indicated by several lateral notches, limbless. Posterior portion of trunk not swollen. Last segment completely fused with trunk, subequal in width to preceding segments, and issuing slender caudal furcae from lateral sides.

First antenna four-segmented as in other species, but differing from them only in scantiness of spines. Second antenna, mandible and maxilla roughly as in other species. Maxilla dentate on terminal claw. Two pairs of thoracic legs biramous, composed of lamellar protopodite and one-segmented rami. Protopodite indistinctly two-segmented and with an outer subterminal seta in both pairs. Exopodite tipped with four and endopodite with two sharp claws in first pair. Both rami of second pair with three claws.

Remarks

The four species described above are distinguishanle from one another by the morphological features in both sexes. It is regretted that any specimens of *S. verrucosus* and *arcticus* have been inaccessible to the author and that the male remains unknown in the former. Judging from the accounts and figures given by those authors (Hjort 1895, Dollfus 1928, Aitken 1942 and Kuitunen-Ekbaum 1947) with respect to these exotic species, the four Japanese forms can hardly be synonymous with either of them. According to Dollfus' figure on *verrucosus* (1928, Fig. 1), the

female abdomen of this species has the tubercles on the first three segments. Of the other five species inclusive of the four described here, *japonicus* alone has the three anterior tuberculated abdominal segments. This species is, however, different from *verrucosus* in having the last abdominal segment bifurcated. *S. pacificus, komaii* and *shiinoi* bear each a certain resembrance to *arcticus* in missing tuberculation on the third abdominal segment. But the former differ from the latter in having tubercles of similar appearances through thorax and abdomen. The male of *arcticus* is very slender, the ratio of width to length being 0.22–0.23 (from Kuitunen-Ekbaum's Fig. 1c, 1947 and Aitken's Fig. 1, 1942). The ratio surpasses 0.27 in any of the species here dealt with. Further, *pacificus* and *japonicus* are distinct from *arcticus* in the first antenna of the first nauplius.

Sarcotaces sp. Yamaguti resembles *verrucosus* and *japonicus* in that the third abdominal segment is covered with tubercles, and in that many of the thoracic tubercles are lobated at the tip. Whether Yamaguti's *Sarcotaces* is synonymous with either of them cannot be judged for its insufficient original description.

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